WHAT IS CLAIMED IS:

1. A reflectometer which operates below deep ultra-violet (DUV) wavelengths, the reflectometer comprising:

a light source that creates light including wavelengths below DUV wavelengths, the light being utilized to create at least one light beam in the reflectometer;

at least one environmentally controlled chamber in which the light beam travels, the chamber sufficiently controlled to allow transmission of wavelengths below DUV light;

a spectrometer that receives at least a portion of the light beam, the spectrometer providing multiple spatially separated wavelengths of light at an exit plane of the spectrometer, the multiple spatially separated wavelengths of light including wavelengths of light below DUV wavelengths; and

an array detector that receives the multiple spatially separated wavelengths of light, the array detector detecting data for wavelengths below DUV wavelengths.

2. The reflectometer of claim 1, wherein the light source is a broad band or narrow band vacuum ultra-violet (VUV) source.

3. The reflectometer of claim 2, wherein the light source is a broad band VUV source that is a deuterium lamp equipped with a window fabricated from a VUV transmissive material.

4. The reflectometer of claim 3, wherein the VUV transmissive window is comprised of at least one of fused silica, fluorine-doped fused silica, quartz, CaF, SrF, BaF, MgF_2, LaF or LiF.

5. The reflectometer of claim 1, wherein the light source is a windowless source.

6. The reflectometer of claim 5, wherein the windowless source is a differentially pumped discharge source.

7. The reflectometer of claim 1, wherein the at least one environmentally controlled chamber is purged with a gas which is selected to be substantially non-absorbing over the wavelength range employed in the reflectometer.

8. The reflectometer of claim 7, wherein the non-absorbing gas is comprised of at least one of nitrogen, argon or helium

9. The reflectometer of claim 1, wherein the at least one environmentally controlled chamber is evacuated.

10. The reflectometer of claim 1, comprising at least two environmentally controlled chambers coupled via at least one coupling mechanism.

11. The reflectometer of claim 10, wherein the at least one coupling mechanism is an optical window fabricated from a VUV transmissive material.

12. The reflectometer of claim 11, wherein the VUV transmissive material is comprised of at least one of fused silica, fluorine-doped fused silica, quartz, CaF, SrF, BaF, MgF_2, LaF and LiF.

13. The reflectometer of claim 10, wherein at least one of the environmentally controlled chambers is purged with a gas which is selected to be substantially non-absorbing over the wavelength range employed in the reflectometer.

14. The reflectometer of claim 13, wherein the non-absorbing gas is comprised of at least one of nitrogen, argon or helium.

15. The reflectometer of claim 10, wherein at least one of the environmentally controlled chambers is evacuated.

16. The reflectometer of claim 10, wherein the at least one coupling mechanism is a controllable vacuum gate valve.

17. The reflectometer of claim 16, wherein at least one of the environmentally controlled chambers is purged with a gas which is selected to be substantially non-absorbing over the wavelength range employed in the reflectometer.

18. The reflectometer of claim 17, wherein the non-absorbing gas is comprised of at least one of nitrogen, argon or helium.

19. The reflectometer of claim 16, wherein at least one of the environmentally controlled chambers is evacuated

20. The reflectometer of claim 1, wherein a beam conditioning module is introduced between the source and the spectrometer for the purposes of modifying the spatial, temporal, or spectral properties of the of the source beam.

21. The reflectometer of claim 1, the reflectometer being configured to be compact so as to facilitate integration into process tools so that in in-line measuring, monitoring or control may be advantageously obtained.

22. The reflectometer of claim 1, wherein reflectometer optics, the spectrometer and the array detector are configured so as to enable reflectance measurements to be simultaneously performed on multiple sites within a localized region of a sample.

23. The reflectometer of claim 22, wherein at least one element of the reflectometer optics is a reflective optic.

24. The reflectometer of claim 23, wherein the reflective optic is an off-axis parabolic mirror.

25. The reflectometer of claim 24, wherein the off-axis parabolic mirror has undergone polishing to remove diamond turning artifacts introduced during its manufacture in order to improve imaging performance.

26. The reflectometer of claim 24, wherein the off-axis parabolic mirror is designed to operate 90° off central ray axis of mirror.

27. The reflectometer of claim 23, wherein the reflective optics are coated with broad-band reflective coating to enhance reflectivity in regions below DUV.

28. The reflectometer of claim 27, wherein the broad-band reflective coating is comprised of aluminum and MgF_2.

29. The reflectometer of claim 22, wherein the array detector is a charge coupled device (CCD).

30. The reflectometer of claim 29, wherein the CCD is of the back-thinned, back-illuminated design.

31. The reflectometer of claim 22, wherein the spectrometer is an imaging spectrometer designed in such a manner as to provide stigmatic imaging in a large area flat field through incorporation of corrective optics.

32. The reflectometer of claim 22, wherein a beam conditioning module is introduced between the source and the spectrometer for the purposes of modifying the spatial or temporal coherence of the light beam or for modifying the spectral properties of the light beam.

33. A reflectometer which operates below deep ultra-violet (DUV) wavelengths, the reflectometer comprising:

a light source that creates light including wavelengths below DUV wavelengths, the light being utilized to create at least one light beam in the reflectometer;

a plurality of environmentally controlled chambers in which the light beam travels, the chambers sufficiently controlled to allow transmission of light wavelengths below DUV, at least one of the chambers being a sample chamber configured to hold a sample from which reflectance data is desired to be collected;

a spectrometer that receives at least a portion of the light beam and provides at least a portion of the light beam as a spectrometer output; and

a detector that receives the spectrometer output, the detector detecting data for wavelengths at or below DUV wavelengths.

34. The reflectometer of claim 33, wherein the detector is an array detector.

35. The reflectometer of claim 34 wherein the array detector receives multiple spatially separated wavelengths of light to enable reflectance data to be simultaneously obtained for multiple sites within a two-dimensional sample area.

36. The reflectometer of claim 33 wherein the spectrometer includes a fixed diffraction grating.

37. The reflectometer of claim 33 wherein the light beam is a non-polarized light beam.

38. The reflectometer of claim 33, wherein at least one of the plurality of environmentally controlled chambers is purged with a gas which is selected to be substantially non-absorbing over the wavelength range employed in the reflectometer.

39. The reflectometer of claim 38, wherein the non-absorbing gas is comprised of at least one of nitrogen, argon or helium.

40. The reflectometer of claim 33, wherein at least one of the plurality of environmentally controlled chambers is evacuated.

41. The reflectometer of claim 33, further comprising at least one optical coupling mechanism between two of the environmentally controlled chambers.

42. A method of collecting reflectance data from a sample utilizing a reflectometer, including collecting reflectance data for wavelengths below deep ultra-violet (DUV) wavelengths, the method comprising:

creating light wavelengths below DUV wavelengths, the light being utilized to create at least one light beam in the reflectometer;

transmitting the light beam in at least one environmentally controlled chamber;

controlling the environment within the at least one environmentally controlled chamber to allow transmission of wavelengths below DUV light;

directing the light beam on a sample;

receiving at least a portion of the light beam within a spectrometer after the light beam has been reflected from the sample;

providing multiple spatially separated wavelengths of light at an exit plane of the spectrometer, the multiple spatially separated wavelengths of light including wavelengths of light below DUV wavelengths; and

receiving the multiple spatially separated wavelengths of light with an array dectector, the array detector detecting data for wavelengths below DUV wavelengths in order to collect sample reflectance data for wavelengths below deep ultra-violet (DUV) wavelengths.

43. The method of claim 42, further comprising detecting with the array detector reflectance measurements simultaneously from multiple sites within a localized region of the sample.

44. The method of claim 42, wherein the light beam in non-polarized.

45. The method of claim 42 wherein the light beam is transmitted through a plurality of environmentally controlled chambers.

46. The method of claim 45 wherein one of the environmentally controlled chambers is a sample chamber.

47. The method of claim 46 wherein one of the environmentally controlled chambers is an instrument chamber, the sample chamber and the instrument chamber being coupled with an optical coupling mechanism through which the light beam passes.

48. The method of claim 47, further comprising detecting with the array detector reflectance measurements simultaneously from multiple sites within a localized region of the sample.

49. An optical reflectometer for obtaining reflectance data from a two-dimensional sample area, the reflectometer comprising:

a light source providing a light beam;

a plurality of optical elements configured to direct the light beam to and from a two-dimensional sample area;

a spectrometer that receives the light beam, the spectrometer providing multiple spatially separated wavelengths of light at an exit of the spectrometer; and

an array detector that receives the multiple spatially separated wavelengths of light to enable reflectance data to be simultaneously obtained for multiple sites within the two-dimensional sample area.

50. The reflectometer of claim 49, wherein at least one of the optical elements is a reflective optic.

51. The reflectometer of claim 49, wherein the array detector detects and resolves reflectance data for wavelengths of light below DUV wavelengths.

52. The reflectometer of claim 51, wherein at least one of the optical elements is an off-axis parabolic mirror.

53. The reflectometer of claim 52, wherein the off-axis parabolic mirror has undergone conventional polishing to remove diamond turning artifacts introduced during its manufacture in order to improve imaging performance.

54. The reflectometer of claim 52, wherein the off-axis parabolic mirror is designed to operate 90° off central ray axis of mirror.

55. The reflectometer of claim 51, wherein at least one of the optical elements is coated with broad-band reflective coating to enhance reflectivity below DUV wavelengths.

56. The reflectometer of claim 55, wherein the broad-band reflective coating is comprised of aluminum and MgF_2.

57. The reflectometer of claim 51, wherein the array detector is a charge coupled device (CCD).

58. The reflectometer of claim 57, wherein the CCD is of the back-thinned, back-illuminated design.

59. The reflectometer of claim 51, wherein the spectrometer is an imaging spectrometer designed in such a manner as to provide stigmatic imaging in a large area flat field through incorporation of corrective optics.

60. The reflectometer of claim 51, wherein a beam conditioning module is introduced in the light beam for the purposes of modifying the spectral, spatial or temporal characteristics of the light beam.

61. The reflectometer of claim 51, further comprising at least one environmentally controlled chamber in which the light beam is transmitted.

62. The reflectometer of claim 61, further comprising a plurality of environmentally controlled chambers, at least one chamber being a sample chamber.

63. A method of analyzing the reflectance characteristics of a sample utilizing a reflectometer, the method comprising:

providing at least one light beam;

directing the light beam on a two-dimensional area of a sample;

receiving at least a portion of the light beam within an imaging spectrometer after the light beam has been reflected from the sample;

providing multiple spatially separated wavelengths of light at an exit plane of the spectrometer; and

receiving the multiple spatially separated wavelengths of light with a two-dimensional array detector in order to allow reflectance data to be simultaneously obtained for multiple sites within the two-dimensional area of the sample.

64. The method of claim 63, wherein the reflectance data includes data over the range wavelengths of the multiple spatially separated wavelengths for each of the detected multiple sites of the two-dimensional area of the sample.

65. The method of claim 63, further comprising performing pattern recognition with a camera so that the reflectance data is obtained from a desired two-dimensional area of the sample.

66. The method of claim 63, wherein the reflectance data resolved by the array detector includes data for wavelengths below DUV.

67. The method of clam 66, wherein the reflectance data resolved by the array detector includes data for wavelengths less than about 140 nm.

68. The method of claim 66, further comprising:

transmitting the light beam in at least one environmentally controlled chamber; and

controlling the environment within the at least one environmentally controlled chamber to allow transmission of wavelengths below DUV light.

69. The method of claim 68, wherein the at least one environmentally controlled chamber is a sample chamber.

70. The method of claim 68, wherein the light beam is transmitted through a plurality of the environmentally controlled chambers.

71. The method of claim 70, wherein one of the environmentally controlled chambers is a sample chamber.

72. The method of claim 71 wherein the reflectance data resolved by the array detector includes data for wavelengths less than about 140 nm.